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PROTECTIVE IRRIGATION WORKS,  
RAJPUTANA.

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INSPECTION NOTE

ON

IRRIGATION WORKS AND PROJECTS,  
JHALAWAR STATE.

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1905.

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1905.



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MAP OF JHALAWAR STATE, 4 miles = 1 inch.  
showing all Projects and Sites referred to in Report.

# INSPECTION NOTE ON IRRIGATION WORKS AND PROJECTS, JHALAWAR STATE.

Mr. Lakshmi Datt, Assistant Engineer-in-charge of the State Public Works Department, joined his appointment in April 1904. His establishment at present consists of:—

P. W. D.  
Establishment.

Sub-overseer Bindra Ban ; Sub-overseer Mumtaz Ali ; Moharrir Rameshwar Pershad ; and 2 Clerks, 1 Munshi, 1 Cashier, 1 Draftsman.

2. This year's budget is sanctioned for Rs. 40,000, of which Rs. 25,000 is for Irrigation, viz., Rs. 5,000 for repairs, Rs. 20,000 for new works.

Budget  
Grant.

3. The Irrigation Works inspected, and new projects and sites visited are noted below:—

Inspected on 1st February 1905. Work was in progress on the Irrigation ducts ; without these no advantage is possible from the Tank. (See Appendix IX, Report by Colonel Sir S. Jacob, Consulting Engineer for Irrigation in Rajputana). An Estimate for Rs. 700 has been sanctioned for their construction.

Stratton  
Sagar  
(Site No. 1)

On right duct 35 chains have been partly excavated, and 17 chains remain to be done. 78 bighas of land have been irrigated this year, and 25 bighas more will be commanded when the work is finished.

On left duct 85 chains have been partly excavated, and 15 chains more can be done later ; 800 bighas are commanded, but there are no cultivators available, and only 12 bighas have so far been taken up, and this by the State.

4. Inspected on 1st February 1905. (See Appendix V, Consulting Engineer's Report).

Nawa  
Talao.  
(Site No. 2)

This is an old tank, but leaks badly, owing to the nature of the rock on which it was built. About 10 bighas are irrigated below from the leakage, and Khan Sahib Sheikh Subhan, who accompanied me, is anxious for a weir to be built across a nullah below to raise the water level, so that the leakage water may pass over a ridge to irrigate a little more land. He also showed me a site above the Talao near the Bhagar enclosure, where he suggested a dam being made, as the weir of the Nawa Talao overflows for days each rains.

The dam would not cost much, as it is a small gap. A masonry core-wall with earth in front and rear would be necessary, and the surplus water would spill over the rocky ridge on either side into the Nawa Talao. There is no land below, and the bed of the new tank formed is rocky and



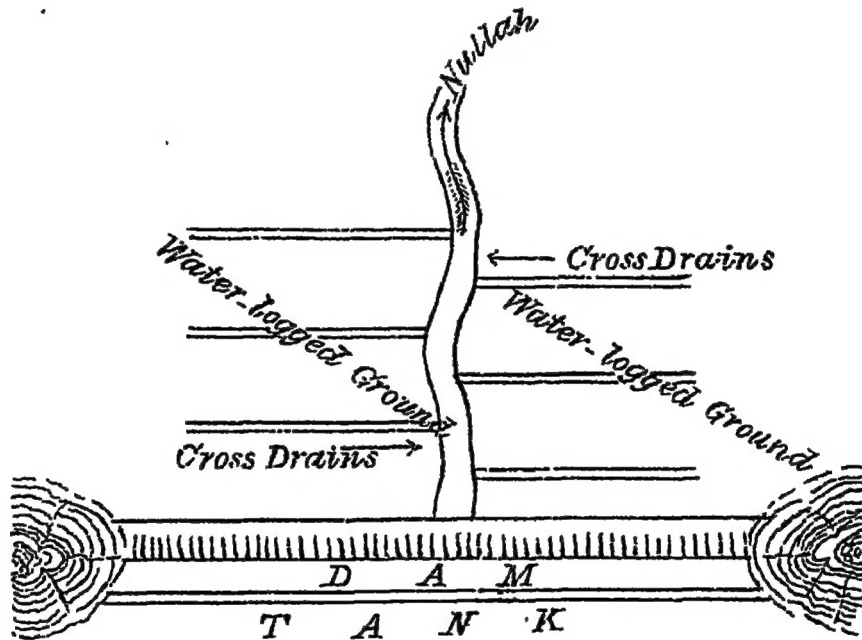
unculturable, so that it would simply form an addition to the city water supply.

I would not therefore recommend spending money on these proposals at present, as it is more urgently required, and can be expended with greater advantage elsewhere in the State.

**Duragpura.**  
(Site No. 3.)

5. Inspected on 2nd February 1905. (See Appendix XIX, Consulting Engineer's Report). The cross cuts suggested by the Consulting Engineer have not been made, but the nullah below the dam into which the leakage flows has been bunded up lower down and diverted into the fields for Irrigation, and the Assistant Engineer informs me that 78 bighas have been irrigated in this way.

During the next hot weather, these cross cuts from the water-logged ground on either side the Nullah should be made as per sketch.



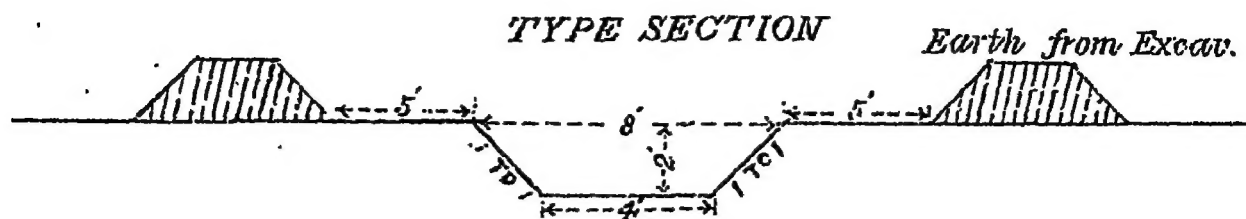
**Kishenpura**  
(Site No. 4.)

6. Inspected on 2nd February 1905. (See Appendix X, Consulting Engineer's Report).

The Irrigation channels are in progress, and an estimate for Rs. 900 has been sanctioned for their construction.

On the right bank 111 chains out of the 130 chains estimated for and set out have been partly excavated; and on the left bank 17 chains in extension of the 30 chains originally executed when the tank was constructed. In excavating the channels vertical sides have been given to save expense, and the earth excavated has been thrown up anyhow on either edge, even on sloping ground. This is a mistake, as in black soil the vertical sides will give way, and the earth on the edges is liable to fall in at any time. Except in rock and hard morrum, a slope of 1 to 1 should be given to the sides when constructing the channels, templates being constructed of the section of channel as a guide to the mates in charge.

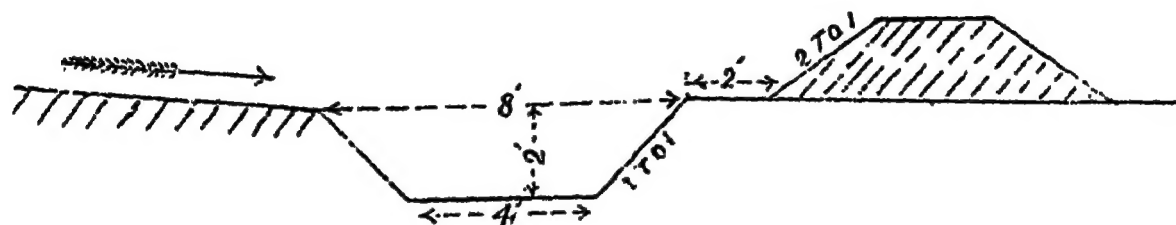
On level ground, a berm of *at least* 5 ft. on either side should be given, and the earth excavated formed into a bank of proper section.



It will be found more economical to do this at once, will save any chance of sides and earth excavated falling back into the channel, and the channel can also be widened later if found necessary.

On side-long ground the earth excavated should be formed into a bank on the *lower side only*; and any surface drainage in the rains will then pass away down the channel.

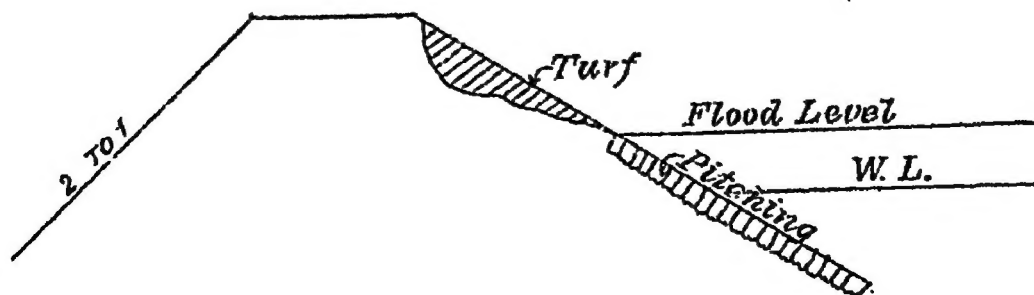
The earth which has now been thrown up above the channel should be removed, otherwise in the rains it will all be washed back into the channel again, and cause trouble.



The apron below weir recommended by Consulting Engineer has been made, but later on, when there are funds, I would recommend the weir being placed at the south-east end by the Kishenpura Village, where there is rocky high ground, and the water would spill over this without doing harm, into the nullah below.

The dam would be extended on the north-west beyond the present weir till high ground is reached. At present the flood water damages the fields below at this end, and if the weir was altered I understand 25 bighas extra could be irrigated.

The front slope of dam, especially at south-east end, wants making up, as it is cut up by waves, etc.; and it should be turfed down to flood level and pitched below, to prevent a recurrence of this.



Pitching is also required on the north-west side of sluice.

Increasing  
Catchment  
of Gaonri  
Tank.  
(Site No. 5.)

7. The Diwan Sahib spoke to me about the possibility of further increasing the catchment of the Gaonri Tank

In Appendix III of Consulting Engineer's Report it is stated, "the tank usually does not more than half fill, owing to its very small catchment ( $1\frac{3}{4}$  square miles); a rainfall of 40 inches or more will fill it." In Mr. Tickell's time feeders were constructed along the foot of the hills, both from the south-west and north-east, and apparently Rs. 3,678 (Appendix VII) was spent on this.

The north-east feeder cuts off a portion of the Kishenpura and Duragpura tanks' catchment, and nothing more can be done without further injury to these and the Stratton Sagar, unless, as suggested by the Assistant Engineer, similar feeders were made on the south side of the range of hills, and taken by a cut through the gap in the hill by Raipura. But this would be expensive, and as the Gaonri is only used for irrigating a few gardens, it would not, it is thought, be wise to do any thing further likely to damage the three tanks named above, which command good irrigable land, or to spend money on the Gaonri, till other tanks of more importance in other parts of the State are carried out.

Mandliakheri.  
(Site No. 6.)

8. On 3rd February went along the line of the Left Irrigation Duct beyond the Stratton Sagar, up to Mandliakheri Tank. (See Appendix VIII, Consulting Engineer's Report).

The Left Irrigation Channel starts about 20 ch. above the road dam on Asuawar Road (para. 9, Appendix VIII), just below Chandrawati Temple, where a weir has been built on sound rock. The channel has 5 ft. bed width and 2 ft. depth, and is nearly all in excavation. It has been excavated for 3 miles, turning to the north-west along the foot of the hills on which the fort is situated, below Gandher village, and has been surveyed for  $1\frac{1}{2}$  miles more. When completed it will have a total length of  $4\frac{1}{2}$  miles, and will command all the land between the hills and the Kali Sindh River, up to the point where the Stratton Sagar River duct comes into play.

A revised Estimate for Rs. 1,800 has been submitted for this duct and Rs. 1,300 spent to date.

The Right duct has also been partly excavated for 2 miles up to the Jaoria Nullah, and surveyed for  $4\frac{1}{2}$  miles further on; when completed it will have a total length of  $6\frac{1}{2}$  miles, and will command 5,000 bighas.

The same rules for carrying out the work, noted in para 6 above should be followed, as the same mistakes have been made; and as the excavation is still in progress the necessary alterations should be carried out at once.

Dam.—The points noted by the Consulting Engineer in Paras. (1), (2), (3), (4), (5), (6), and (7) of Appendix VIII, have been carried out or are in progress.

With regard to para. (8) the flood water has cut away the surface earth at the south weir down to rock, lowering the weir level to nearly 5 ft.

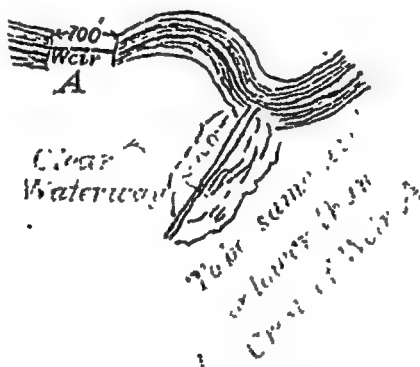
The water is cutting away the toe of the rear slope of the dam and a large area of good culturable land, in finding its way down to the nullah.

The Assistant Engineer proposes continuing the dam at this end on to high ground, and closing this weir altogether.

The north weir is 700 ft. in length, and forms the weir of the combined Mandliakhera and Patan tanks. The catchment area of the two is  $7 + 18 = 25$  square miles, and the maximum discharge on this (by Dicken's Formula) 9,223.5 cusecs.

A weir 700 ft. long will discharge this with a  $2\frac{1}{2}$ -ft. head.

If the south weir is closed altogether—and I think it certainly should be done—levels must be taken to see that the ridge dividing the two catchments of the Mandliakheri tank is not higher than crest of the north weir. If it is, the ridge must be cut down to this level for 700 ft. in



length, to give a clear water passage for the flood water to the weir, otherwise the water will head up and there will be danger to the dam.

9. There is an old Masonry Irrigation Duct from the Patan tank. This has a section of 2 square ft., and is  $2\frac{1}{2}$  miles long, ending on the north of the Fort Hill, before Ghandan village is reached.

Patan Tank  
(Site No. 7.)

The Assistant Engineer has made surveys for extending this 50 chains, to command 300 bighas above the Mandliakheri Duct.

If there are cultivators to take up the land this extension should be carried out, as at present only 264 bighas are irrigated from the Patan tank. (See Appendix IV, Consulting Engineer's Report).

10. Inspected on 4th February 1905 (See Appendix XX, Consulting Engineer's Report).

Sarangakheri Tank  
(Site No. 8.)

The site shown us, and the villagers said it was the same as shown to the Consulting Engineer, is about  $\frac{1}{4}$  of a mile south of Sarangakheri village, where the river runs through high rocky ridges. There is rock in the river bed, and low hills of boulders of trap on either side, about 900 ft. apart. The basin is contracted, but all waste land; and there is good land below.

If a dam is built here, a masonry face-wall will be necessary, as earth is scarce; and levels should be taken back from the land on the north of

the village to fix approximately sill level of sluice; and the weir level might be made 7 ft. higher than this, and the crest of dam 5 ft. above this again.

This site does not appear to correspond with the plans for the storage reservoirs proposed by Mr. Miles for the water supply of Patan city and Chaoni. There were no prismatic surveys taken and no permanent bench marks left to show the site; but the dam was 3400 ft. long, and the report of the water-works project says the site was  $1\frac{1}{2}$  miles above Sarangakheri village.

Moharrir Rameshwar Pershad, who was sent by the Assistant Engineer to fix the line of dam, from the bearings and length laid out the site about a mile below Sarangakheri village, between Mangal village on the left and Jarer village on the right bank.

This site was inspected, and a little above the line fixed by the Moharrir there is a splendid site (Site No. 9) for constructing a storage reservoir for Irrigation. There is a grand basin, all of black soil, at present uncultivated, which would produce wheat as the water of the reservoir receded; there is good earth all along for the dam, and any quantity of land below for irrigation, stretching away between Kishenpura and Chandiakheri on the right and from Mangal towards Patan city on the left bank.

The catchment area is  $16\frac{3}{4}$  square miles, and allowing 10 per cent. of the average rainfall of 30 inches, 117 m.c.ft. of water should be available for storage sufficient for 1170 acres.

The dam would start from a babul tree at the south corner of Jarer village on the right bank, across to a tika tree on the left, and on to the ridge till the necessary level for crest of dam was reached.

The weir would be on the right bank on the high ground by Jarer village. The right bank of the nullah is high and perpendicular; on the left the ground slopes away gradually. A core-wall would be advisable across the nullah portion, but the rest of the dam would be entirely of earth, black soil similar to the Mandliakheri tank.

The dam would be about 1 mile long, and taking the Mandliakheri dam as a guide, would cost about Rs. 50,000.

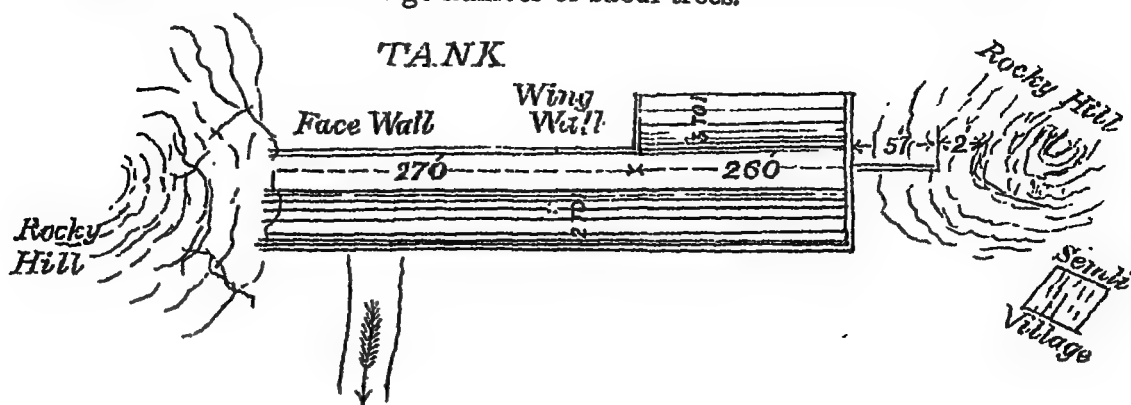
This is a most promising project, and if funds were available, and also sufficient cultivators, should be carried out without delay. Surveys should certainly be made and the project worked out, and the Assistant Engineer informs me that he will have this done under his own directions.

**Semli Tank**  
(Site No. 10.)

11. This small tank was built in 1878 by Mr. Miles.

The total length of dam is 530 ft., with a weir 78 ft. in length at north end, near the village. At the south end where it crosses the nullah, the dam has a masonry face-wall 270 ft. in length, backed with earth, and for

the remaining 260 ft. up to the weir is entirely of earth-work. On the dam there are now a large number of babul trees.



There is no sluice, the water is lifted by charas for Irrigation and six are at work.

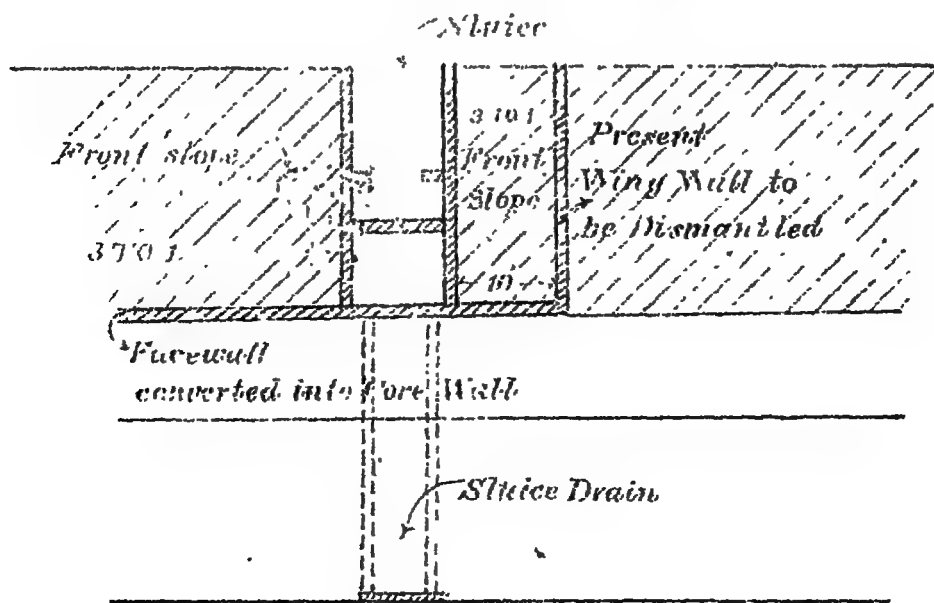
The tank has a catchment of 1 square mile, all hilly; capacity of 1.98 m. c.ft.; and about 40 bighas are irrigated. The villagers are most anxious for the weir and dam to be raised, as it overflows every year and there is plenty of land available for irrigation below.

With the hilly small catchment 20 per cent. of the average rainfall of 30 inches should certainly be available for storage, or 13 m.c.ft., sufficient for 130 acres or 325 bighas.

It would therefore seem well worth raising the weir and dam and building a sluice.

The Assistant Engineer should check the present capacity, and take contours of the basin to find the height the weir should be raised to give the proposed capacity. The maximum flood on 1 square mile is 825 cusecs, and this can be discharged by the 78 ft. weir with 2-ft. head, so crest of dam should be made 5 ft. above new weir level.

The babul trees should be removed and sold, and all roots removed before adding the new earth; and the face-wall might be converted into a core-wall, and to prevent any chance of water creeping round, the sluice should be fixed 10 ft. from the wing-wall, which should be dismantled as it is all cracked. The sketch shows what is suggested.



Motipura.  
(Site No. 11.)

12. The site for this small project, which has been worked out by the Assistant Engineer, was inspected on the morning of 5th February. This is one of the Irrigation Works proposed by Mr. Tickell in Appendix E of his Report.

The site is just above the villages of Motipura (Khalsa) on the right bank and Samrai (Jagir) on the left.

The basin is very flat, entailing a long bund and little storage, the greatest depth being 9 ft., so a shallow tank will be formed. The following are the details taken from the Report of Estimate :—

Earthen Dam	...	...	...	4,200 ft. long.
Weir	...	...	...	300 ft. long,
at east end on right bank of nullah.				
Catchment Area	...	...	...	6 sq. miles.
Capacity	...	...	...	28.48 m.c.ft.
Available for Irrigation	...	...	...	27.43 „
Area available for Irrigation	...	...	...	600 bighas.
Cost of Project	...	...	...	Rs. 9,520

Probable Revenue @ 2 rupees per bigha = 1,200 rupees, or nearly 13 per cent. profit.

This is irrespective of the bed, about 200 acres, which is at present uncultivated and could all be sown with wheat as the water recedes. The value of water stored is 2,989 c.ft. per rupee, so it is a cheap project and should certainly be carried out, as in addition to the extra land brought under cultivation the wells will be benefitted. Of the 40 wells in Motipura I was informed that only 25 are now in use, for want of water.

Before starting the work, the following corrections appear necessary :—

From topographical Survey the catchment is 7.5 square miles ; from this the maximum discharge (Dickens Formula) is 3.737 cusecs. and the length of weir required to discharge this with 2-ft. head is 375 ft.

The dam is proposed to be 6 ft. wide at top, with front slope  $2\frac{1}{2}$  to 1 and rear slope 2 to 1. Crest 5 ft. above weir level. The front slope should be made 3 to 1. The size of Sluice and Irrigation Channel required is not given, these should be worked out always by—

(a) Finding the discharge per second required to empty the tank in four months (Rabi Irrigation season) ;

(b) And as water is required simultaneously at first for Irrigation. the discharge required per second to give a first watering of 6 inches in 30 days of 12 hours' flow to the whole area for which there is sufficient water.

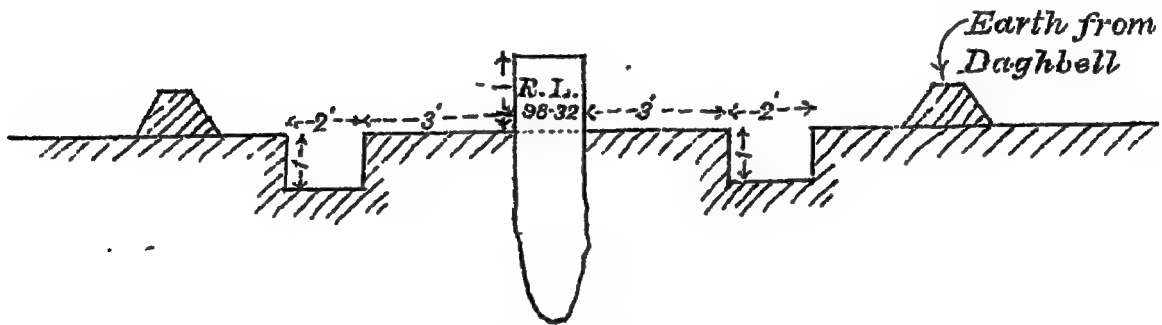
This has been explained in detail to the Assistant Engineer.

The line of the proposed dam was not daghballed out, nor were there any permanent bench marks. Wherever

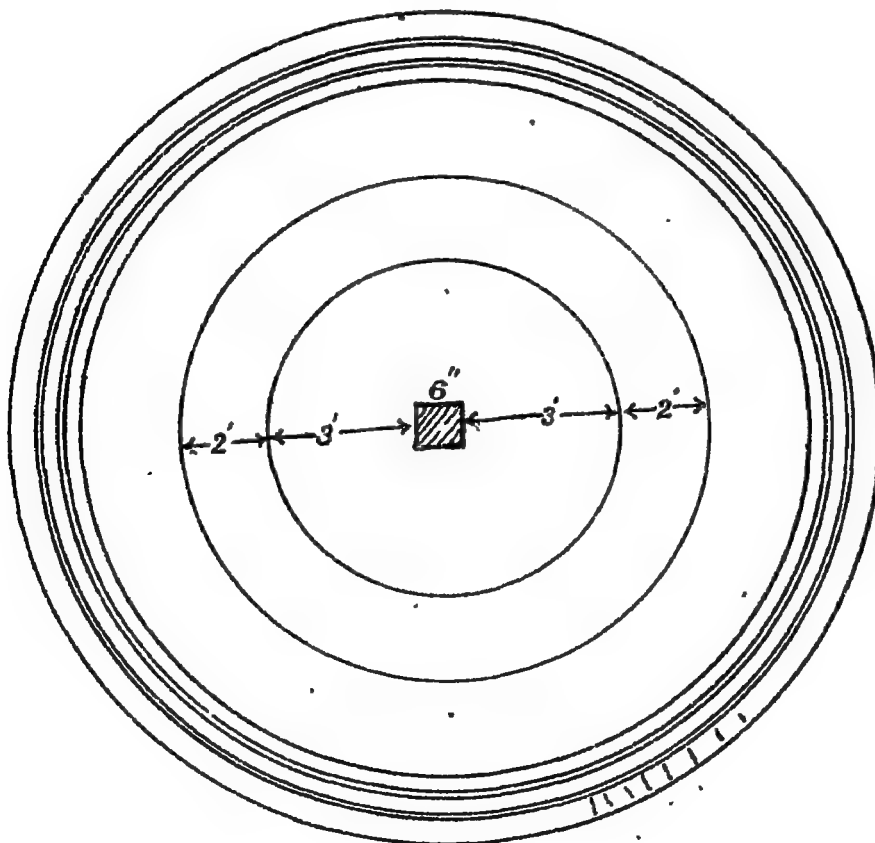
projects are surveyed, for check and future reference, the Assistant Engineer should arrange always to have :—

- (a) The line of dam clearly daghbelled from end to end, 1 ft. wide and 1 ft. deep.
- (b) Permanent bench marks erected, cut out of the rock in river beds or where rock occurs, along the line of dam, showing the bed level of nullah, and every 5 ft. rise, also at any point where the line changes. Also at ends of the base line and cross-section lines of survey.

These bench marks should be stones set on edge, embedded  $1\frac{1}{2}$  in the ground, with a circular daghbell all round as per sketch, the number and reduced level, corresponding with Field Book, being marked on the stone.



SECTION



PLAN

If this was done there would be no difficulty in finding the sites, check-



ing the work, and setting it out whenever it was decided to take it up, even should this be a year or two after the surveys were made.

**Shamia**  
(Site No. 12).

13. Inspected on 5th February (See Appendix XVII of Consulting Engineer's Report).

This is a Jagir village, belonging to the Maharani Rahtoriji; and I was accompanied by the Kamdar Raja Ram and Patwari. In accordance with the Consulting Engineer's suggestions, surveys will be made by Surveyor Overseer Mannu Lal to enable plans and estimates for restoring and enlarging the old dam just above the village. The breached portion across the nullah will be closed by a strong earthen dam, well trenched into the bed, and sides of the nullah and existing dam; and the old surface for the entire length must be dug up, and all grass, roots and bushes removed before new earth is commenced.

The weir will be at the north end, where the water will spill down to the Rewa naddi.

The catchment area is 3.75 square miles, so that allowing 10 per cent. of average rainfall of 30 inches we can count on storing 26 m.c.ft. sufficient for 260 acres, more than the existing land, but the excess water will be useful for the village and cattle.

**Rewa River**  
**Project**  
(Site No. 13).

14. From Shamia the sites suggested by the Consulting Engineer (Appendix XII) at Khod and Imliakheri for the Rewa River project were inspected.

This is a very large project, and it is doubtful whether it will be worth working out in detail, but orders for preliminary surveys to give sufficient data to enable a decision to be made have been ordered, and will be carried out by Surveyor Mannu Lal. The best site, it is thought, for the dam will be starting from high ground south of Panchakheri village on the left bank, across the river just south of Khod, where the line would turn to the south-east till high ground is reached.

The catchment area at the site is 136 square miles, and allowing 10 per cent. of the average rainfall of 30 inches this would give 952 m. c.ft. of water for storage, sufficient for 9,500 acres, if all could be used. The river is about 150 ft. broad, and the banks 20 ft. high, and the land to be irrigated is high, so a great portion of the water stored in the river bed will, it is feared, not be available for irrigation. Imliakheri is a deserted village, but Kharanpura (K) village, south-east of Panchakheri, which contains about ten houses, would probably be submerged.

As it will probably be necessary to enter Indore and Gwalior territory to make the preliminary surveys to see how far the water will spread back, the residents of these States have been addressed, and sanction for this asked for.

**Ramnawaz**  
**Ghatod**  
(Site No. 14).

15. Inspected on 6th February (See Appendix XVI, Consulting Engineer's Report).

The Kamdar Raja Ram and the Patwari met me at these villages.

As pointed out by the Consulting Engineer the only useful thing to be done is to bund up the nullah, which at present passes between the two tanks, and form one tank ; enlarging and repairing the existing dams. The level of the Panchpahar road, which runs along the south-east of the Ramnawas tank, will fix the flood level. The combined catchment is 1 square mile, so 7 m. c. ft. will be available for storage. The representatives of the two villages and tanks want each tank kept separate, but this is not possible if the water of the nullah is to be made use of. When one tank is formed the Ghatod (Jagir) land will obtain the greatest benefit as this tank is at a lower-level ; as they have the larger area of land to irrigate this is as it should be. Both parties wished for surveys to be made and Plans and Estimate for the combined tank prepared, so directions were given for this to Overseer Mannu Lal ; and it is hoped that some agreement will be arrived at for the execution of the work, as it is a great pity to lose water when land is lying idle for want of it.

16. The site of the old bund was inspected on 7th February, with the rough Plans prepared by Mr. Tickell (See Appendix XIII, Consulting Engineer's Report). This project is not approved by the local authorities, and this is satisfactory, as the new railway (Nagda-Muttra) line passes through the bed of the tank, and there will be a Railway bridge across the nullah just below the dam.

Panch-  
pahar  
Tank.  
(Site No. 15).

17. About 4 miles east of Panchpahar a very good site (Site No. 16) for constructing a large storage reservoir and making use of this water was found at the junction of the Panchpahar and Ramti nullahs at Gangpura. The catchment area at this point is 48 square miles, which should allow 336 m. c. ft. of water to be stored, sufficient for 3,350 acres. There is a good basin, and the Irrigation Canal on the right bank could be taken on the water shed from Lasaria to Jhikria ; and all the land down to the border, the bank of the Au river, could be irrigated. On the left the land between Sulia and Semli would be commanded.

Gangpura  
Kundik-  
hera  
Project  
(Site No. 16).

The dam would start from high ground east of Kundikhera, and between that village and Lasaria ; cross the river just below Ganjpura, and on to the high ground on the left bank near the Panchpahar road. Ganjpura would be submerged, but there are only 15 houses now occupied since the Famine, and about 50 inhabitants, and at little cost it could be removed to higher ground.

This is a large project, and not likely to be carried out till the finances of the State improve, and there are more cultivators available ; but with the railway it is hoped great advantage will accrue, and in years to come all the water available will be made use of and all land taken up. Overseer Ram Chander has therefore been directed to prepare the necessary surveys and work out the project, which will be submitted in due course.

18. This was inspected on 8th February.

The work is simple, and the Consulting Engineer's directions in Appendix XVIII, with Plan to illustrate same, so clear, that the Assistant Engineer will have no difficulty in preparing the Project.

Deori  
Feeder  
Channel.  
(Site No. 17).

Nothing has been done so far, but the Assistant Engineer should have the necessary levels taken and estimate prepared without delay. The line of feeder and dam for each storage reservoir should be dagh-belled, and permanent bench marks erected, so that the work can be carried out at any time.

Hatunia.  
(Site No. 18).

19. Inspected on 8th February. The Consulting Engineer has here also given clear directions in Appendix XI of what is required to enable revised Plans and Estimate to be prepared. The Assistant Engineer had not visited the site before; so we went over it together, with the Consulting Engineer's directions; and one of the State Surveyors will be put on to the work, and a revised estimate prepared; and the Durbar will then know what funds are required to finish the work.

The site is such a good one, and expenditure has already been incurred on the work, that there seems every reason for completing the project as soon as possible. The earth at the site is a mixture of black soil and morum, and seems to be excellent for dam construction, as there is not a crack to be seen in any of the work already carried out.

Ratanpura  
(Site No. 19).

20. This is Project No. 8, Appendix E. in Mr. Tickell's Report. Ratanpura village is 3 miles south of Panchpalur, and there is an old dam, which has been lying breached for years. This was inspected with the Assistant Engineer on 9th February.

The nullah runs between a high hill on the left bank and a ridge on the right, starting from Ratanpura village, on which an earthen dam was constructed, the gap through which the nullah flows being dammed by a masonry wall about 200 ft. long, 10 ft. wide at top, and about 12 ft. above the nullah bed.

The water got round at the left bank, and the wall gave way, and is cracked at intervals, and the face masonry is out of repair; trees and bushes are growing out of it at the nullah edge. In the face-wall there are two very good carved images, taken from temples; these should be preserved.

The Assistant Engineer has had surveys made and a project for restoring the dam prepared; the following are the details given by him.

Catchment Area	...	...	...	2 square miles.
Capacity	...	...	...	22 m. c. ft.
Weir level	...	...	...	26 ft. above Nullah bed.
Top of Dam	...	...	...	31 ft.     "     "     "
i.e., 5 ft. above weir.				

Weir, 200 ft. long on the ridge near Ratanpura village.

An earthen dam to be constructed in front of the breached masonry dam, 8 ft. top width, front slope 3 to 1, rear slope 2 to 1.

The ridge on right to be made up to proper levels by earthwork, 5 ft. top width, front slope 3 to 1, and rear slope 2 to 1.

Estimated cost Rs. 7,000.

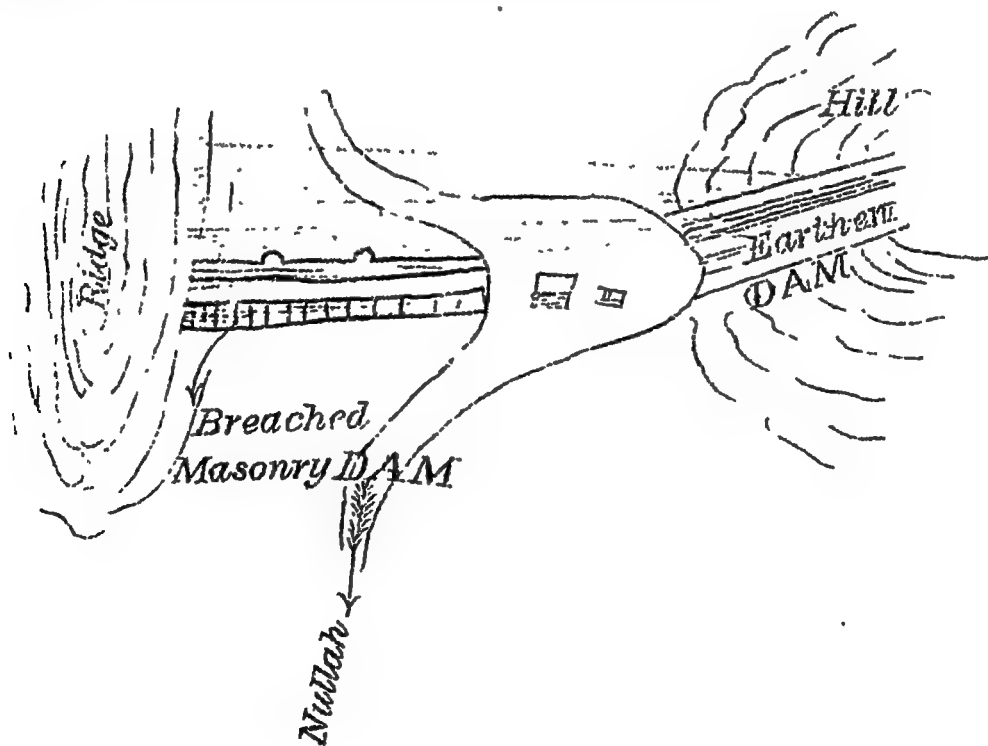
Value of water stored 3,143 c.ft. per rupee.

Revenue for 220 acres = 550 bighas @ Rs. 2 per bigha = Rs. 1,100 per annum or over 15 per cent. profit.

But the catchment area has been over estimated, as from the Topographical Survey Map it is only half a square mile.

This reduces the water available for storage to 7 m. c. ft. even if we allow 20 per cent. of rainfall, as the catchment is hilly. This will therefore reduce the capacity of the tank, and the surveys should be carefully checked and the water-spread and capacity at each 5 ft. contour carefully worked out.

The weir level should be kept at the lowest point of the ridge towards Ratanpura village, and the water allowed to spill over here, even should this give a greater capacity than required; the maximum discharge on the half square mile catchment is 490 cusecs, and as this gap in the ridge is about 400 ft. long the water is not likely to cut it away. The line proposed by the Assistant Engineer for the earthen dam across the nullah may be accepted, but care must be taken that the new dam is entirely separated from the old dam; and the space in rear between should be filled up to the top of the masonry wall to prevent a pool of water being held up between, which would damage the dam.



The line of dam was not daghbelled out, nor were there any permanent bench marks, not even one on the masonry dam, so that it is impossible to check the surveys made by Sub-overseer Muntaz Ali. The directions given in para. 12 should always be carried out.

The Plans made are difficult to estimate from, as the cross sections are drawn to far too small a scale.

They should always be drawn to a natural scale 10 ft. = 1 inch. Directions on this point and a printed copy of one of the projects prepared in this office have been given to the Assistant Engineer as a guide for the future.

Also a copy of "Directions for Surveyors in preparing Irrigation Projects," as this may be useful.

Sarod  
(Site No. 20).

21. Sarod is about 2 miles south-west of Ratanpura, and the villagers are very anxious for a dam to be constructed about 1 mile to west of village, where the nullah, which flows past the village itself, issues from the hills. The Assistant Engineer has had surveys made and the project is being prepared.

The site was inspected with him on the morning of 9th, and the Patel of the village accompanied us.

The details of the project as given by the Assistant Engineer are :—

Catchment Area ...	...	...	7½ square miles.
Capacity ...	...	...	50 m. c.ft.
Length of Dam ...	...	...	1,225 r.ft.
Weir level ...	...	...	29 ft. above nullah bed.
Crest of Dam ...	...	...	5 ft. above weir; and
"			31 above nullah bed.

The line for dam selected by the Assistant Engineer ran just in front of a small tributary nullah from the hills on the right bank, and he proposed to have his weir at the south end at the foot of these hills, the flood water finding its way back to the main nullah by this tributary. It would be better to alter the line to include this nullah inside the basin of proposed tank, and have the weir at the north end, cut out as far as possible from the rocky hill on left bank of the main nullah which flows at the foot of this hill; a core wall would be required in continuation of the weir for the portion of the dam across the nullah and for about 20 ft. into left bank.

The catchment area from topographical Map is only 1½ square miles, not 7½, so that not more than 17.5 m.c.ft. (20 per cent. of rainfall) can be expected for storage.

The survey should be checked, and the Plans and Estimate revised as above, the new line of dam being clearly daghbelled and permanent bench marks left.

Naka  
Sarna  
Guraria  
(Site No. 21).

22. This site was inspected by the Consulting Engineer (and is described in Appendix XIV. of his Report). He considered "it was quite worth while to have Plans and Estimate prepared."

On the afternoon of 9th February we visited the site as well as the others noted by the Consulting Engineer at Guraria, and directions for the necessary surveys were given to Overseer Ram Chandar, who will prepare the Plans and Estimate in due course.

23. This small tank, described by the Consulting Engineer in Appendix XV., was visited on the morning of 10th. Moira  
(Site No. 22).

An Estimate for carrying out the repairs recommended has been sanctioned, and the work has partly been carried out by the Assistant Engineer, but is now at a standstill for want of funds.

The breach at the site of the old weir has been closed, with an earthen dam pitched; the new weir, 200 ft. in length, has been constructed; and now 3 chains of earthen dam at the south end, by the weir, are required.

The top of dam at the sluice also wants making up to proper level, as it has sunk and cracked along the lines of the sluice drain below; the old surface should be well picked up and the cracks carefully filled and consolidated before the new earth is spread. The Assistant Engineer has built a toe-wall of masonry in lime at foot of rear slope, where the dam crosses the nullah. If a toe-wall was necessary it would have been better to build it of dry stone masonry with chips behind, to allow any leakage to pass through clear.

The ridge has also been cut away about a foot to make the weir; this was unnecessary, and reduces the possible capacity of the tank.

As there is a long, practically level, length of stony ridge at the south end, it would have been sufficient to clear this only, and not build any masonry wall for the weir till it was found that the surface cut away.

24. The Napania, Chandarpur and Harnia nullahs were investigated, but nothing is possible on these.

Nullahs  
near Mis-  
rauli and  
Kantali  
Nullah.

The Napania nullah flows through such a level plain that there are no sites for storage reservoirs, and the Chandarpura and Harnia nullahs are in such deep banks, with the land for irrigation high on either side, that if any dam was constructed the greater part of the storage would be in the river bed and unavailable for irrigation.

The Kantali nullah has a rocky bed, but only crosses a narrow strip of Jhalawar before it flows into the Au river on the east border, so that it would not pay to carry out anything on so large a river, even if a site was discovered, with so little land commanded.

25. On 11th, with the Assistant Engineer, inspected the Bani nullahs, with which it is feared nothing can be done, as though on the left bank the land slopes down from the Zalinpura Hill to the nullah, on the right bank it is very level, and if a dam was constructed round towards the Temple Hill behind and south of Bani, the village well lands would be submerged.

Nullahs  
near Kara-  
wan, Bani  
Nullahs.

Gugwa  
Tank  
Project  
(Site No. 23).

- (a) At Gugwa there is a site for a small tank, which His Highness the Raj Rana suggested for inspection. The line was shown to Sub-overseer Pars Ram, who will make the necessary surveys; the catchment area is only half a square mile, so if 20 per cent. of the average rainfall is stored, only 7 m. c. ft. is available, sufficient for 70 acres = 175 highas. There are about 200 highas of land commanded available for irrigation—100 belonging to Gugwa and 100 to Bara Khokria.

Singpura  
Tank  
Site No. 24).

- (b) From Gugwa we went to Singpura and on to a dam about 1 mile to west of the village which was constructed in 1901-1902 by the Tehsildar from plans prepared by Mr. Abdur Rahman, Assistant Engineer.

Mr. Tickell, in Appendix E of his Report, suggests a tank at Singpura, but his description does not agree with the one constructed. The dam is 900 ft. long, closing a gap between low hills, and the weir is over a ridge to the north of the hill at the north-end. Top width of dam is 8 ft.; front slope supposed to be 3 to 1, but appears steeper, and has sunk for the portion of dam across the nullah itself, where it is 35 ft. high. This front slope is pitched up to the top. Rear slope is 2 to 1. A masonry sluice well and drain under the dam has been constructed, but no irrigation channels, so at present no irrigation can be carried out from the tank. The sluice leaks badly, and the outlet chamber at toe of rear slope was filled with earth to reduce this leakage.

The dam is said to have cost Rs. 8,000, and the wells have been benefitted by its construction.

The water level has never risen higher than 10 ft. below crest of dam, and never nearly reached the weir level; there is no mention in Plans and Estimate shown me of the capacity of the tank, but as the catchment area is only .62 of a square mile, the most that can be calculated on for storage is  $8\frac{1}{2}$  m. c. ft. of water.

The Assistant Engineer should check the capacity of the tank, and prepare an Estimate for Irrigation Channels to make use of the water noted above as available for storage.

New Tank  
Project  
near Sing-  
pura  
(Site No. 24).

- (c) There is a site for another small tank on a tributary nullah rising in the hills, about a mile north of the village, and surveys for this will be prepared by Overseer Ram Chandar. The catchment area is about one square mile, all hilly, and allowing 20 per cent. of rainfall 14 m.c.ft. should be available for storage, sufficient for 140 acres, which should benefit Singpura and Harakheri villages.

Betuna  
Nullah.

- (d) The Betuna nullah was next inspected, but nothing appears feasible on this. Between Betuna and Karawan there is a large area of grass land, intersected with small shallow nullahs flowing from west to east to join the main nullah.

Low earthen embankments could be put across each of these, at little cost, to hold up water in the rain, and the beds of the "naddis" so formed could all be cultivated with gram and wheat as the water percolated into the soil.

26. Khandar is  $2\frac{1}{2}$  miles south of Karawan, and the dam constructed across the nullah at this village was inspected on 12th February. The work was carried out by the Tehsil, according to plans prepared by Assistant Engineer Abdur Rahman. The dam is of earth, 12 chains in length, top width 8 ft. 3 to 1 front slope pitched and 2 to 1 rear slope; there are natural weirs at both ends, the ends of the dam being pitched.

Khandar  
Tank  
(Site No. 25).

There is no sluice, and the tank was constructed to benefit the wells below, and this it has done; but the weir level is not high enough to command the land below, which is very high. As, however, there is a large area of good land below, it is thought it would pay well to make a large tank here, extending the dam to the south-east across the Jalni nullah, giving a total catchment of  $8\frac{3}{4}$  square miles; and as a great part of this is hilly, we may allow 15 per cent. of rainfall as available for storage or 92 m. c. ft. of water. As the land below is high, all this would not be available for irrigation, and a part would lie in the low basin by Khandar village, and be useful for the villagers and cattle, and would benefit all the wells below. The higher portion of the bed would all be cultivated as the water receded as used for irrigation. Surveys for this will be made by Sub-overseer Pars Ram, and Plans and Estimate prepared. From flying levels taken the dam will have to be extended about 2,200 ft. to raise the present weir level 10 ft., and the land on right bank between Nathokheri and Pagaria will be commanded.

27. The next nullah south is the one which issues from the hills by Rajpura village and flows into the Kesri Naddi half a mile below and to the east of the village.

Rajpura.  
Project  
(Site  
No. 26).

On this nullah, west of Rajpura, there is a good site for a tank, the dam starting on the right bank from the hill on the south on which Pitapura village stands, crossing to the hill on the left bank at the foot of which the nullah flows, and just below the point where a large nullah joins it on the left bank. The catchment is all hilly and  $3\frac{1}{2}$  square miles so that 20 per cent. of rainfall should be stored, or 49 m.c.ft. of water, sufficient for 490 acres = 1,225 bighas. The dam will be about 1,500 ft. long; a masonry core-wall will be required for the whole length, as the soil is black, mixed with stones, no rock was visible in river bed, and the hills were of boulders and earth. The weir will be on the left bank, cut out of the hill as far as possible.

Three wells will be submerged, 10 bighas of irrigated land, and about 80 bighas of barani.

There is another site above, which would save these wells, and submerge only about 60 bighas of barani, but it would reduce the catchment to  $2\frac{3}{4}$  square miles, a loss of  $10\frac{1}{2}$  m.c.ft. of water and 105 acres of irrigation. Surveys will be made and Estimates for both will be prepared, and the Durbar can then decide which to take up.



The irrigation channel after Rajpura village would have to cross the nullah by an aqueduct—as here it runs in very deep banks—to the land of Binni village on the left, where there is a large area available for irrigation.

Balpur Project not recommended.

28. Another site was shown us south of Baipur where the Kesri naddi flows between the hills, about 2,000 ft. apart. This is probably the site referred to by Mr. Tickell as No. 12 in his Appendix E. The river is a large one running in deep banks, and though the dam would be about 2,000 ft. long (not 10,000 as noted by Mr. Tickell) it would have to be a high one with core-wall, or face-wall, and it would be a very expensive project and beyond the requirements of the Jhalawar State, as the land commanded is on the left bank only, and is the same that the proposed tanks at Rajpura and Khandar will irrigate.

The project is consequently not recommended.

Benaiga Project (Site No. 27)

29. At Awar a large nullah joins the left bank of the Au river. This nullah rises about 9 miles south of Awar, near Harnauda, and flows northward.

About  $3\frac{1}{2}$  miles from its source it passes Benaiga village, where there is a very good site for a storage reservoir. Mr. Tickell mentions this as No. 13 in Appendix E. of his Report, and surveys were made some years ago under his directions; but the line surveyed was for a dam across a tributary nullah only, which joins the main nullah on the left bank just above Benaiga village. This has only a catchment of 1 square mile. The line was not daghbelled, nor were any bench marks available, so all the Surveys will have to be made again (see para. 12). It would, it is thought, be better value to dam the main nullah, with its larger catchment of 4 square miles, which should give 42 m.c.ft. for storage, allowing 15 per cent. of rainfall; and the Irrigation Channels could be taken along the valley on either side the nullah to irrigate Goraria land, as well as Benaiga. The site is a good one, and the Project should not be expensive, as though a core-wall would be necessary the dam would not be a high one. There is a very good basin, at present grass land, and all this could be cultivated with wheat. Surveys for both projects will be carried out, and Plans and Estimates prepared, but the larger project is strongly recommended.

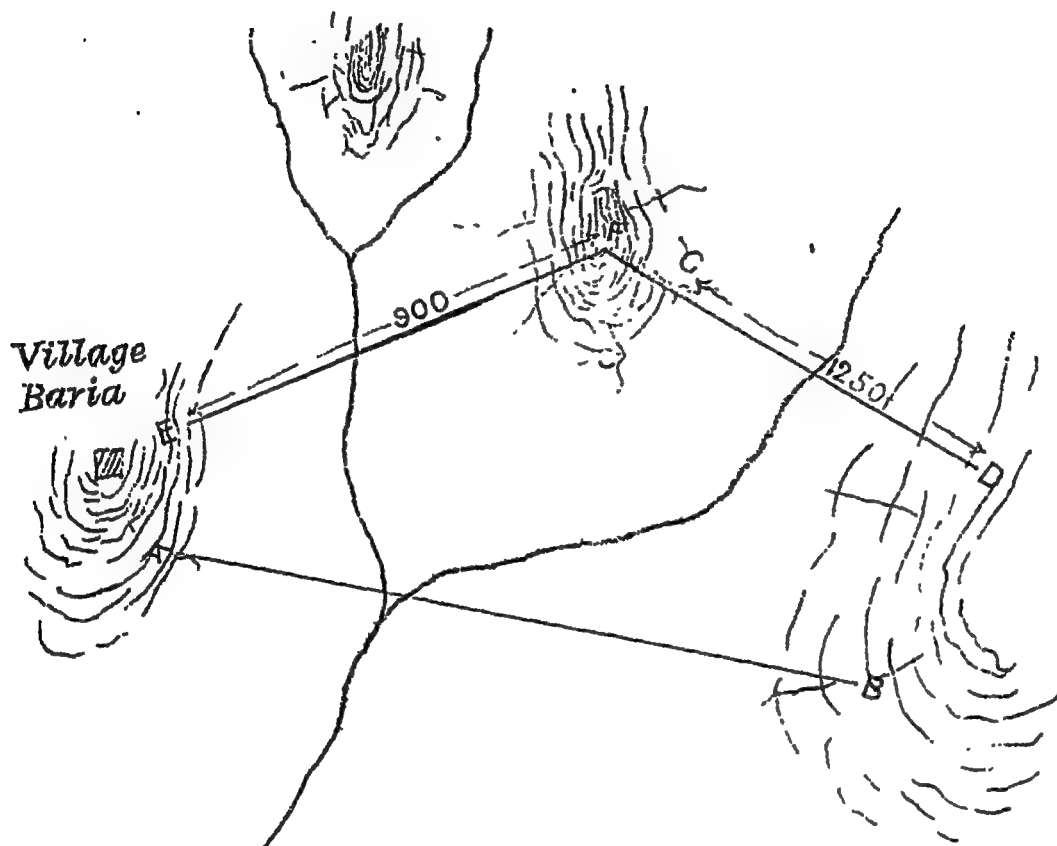
Weir at Jadni. (Site No. 28).

30. Lower down this nullah, at Jadni—a Jagir village  $1\frac{1}{2}$  miles south of Awar—there is an excellent site for constructing a masonry weir across the river to hold up water which could be lifted by odies on to the fields on either side. There is a rock bed, with large rock boulders above, and rock on either bank so that the flood water spilling on this would do no harm. The weir would only be 200 ft. long, and 8 ft. greatest height, so would not cost more than Rs. 1,000 and a fine pool would be held up.

Baria Project (Site No. 29).

31. Further east there is another tributary nullah to the Au river, and the two branches which form this stream rise in the hills to the south-east of Baria, and unite at that village. It would be possible to make a dam just below their junction from the hill on which Baria village

stands across to the hill on the left bank, line A B, but this would submerge 8 wells and 40 bighas of irrigated land, besides about 150 bighas of "mal." It would be better therefore to make two dams, as there is a low range of hills dividing the two, viz., C D and E F,



and surveys and Plans and Estimate will be prepared, as there is good land below, and irrigation can be extended to Gajarni (K) and Khera (K) villages.

The catchment area of C D is 1 square mile, so we should be able to store 14 m.c.ft. of water, allowing 20 per cent. of rainfall. About 50 bighas of "mal" land will be submerged by this tank, but no wells or irrigated land, and the bed will all be cultivated as the water recedes.

The catchment area of E F is also 1 square mile, giving us 14 m.c.ft. of water; and in this tank only 15 bighas of "mal" will be submerged. Mr. Tickell suggests a tank at Baria, vide No. 23 in Appendix E. of his Report.

32. The country south of the Kasri naddi is hilly and undulating and stoney; the culturable land is limited and lies in patches in the valleys near the villages, which are scattered. Though there are many sites where dams could be constructed, many of these are useless for want of land below. This applies to a site about 1 mile west of Malpura village which was inspected on 13th February, at the request of the Political Agent, as many Patels had asked for its construction.

Malpura  
(Site No. 30).

The Patels who met me were most anxious for its construction, as they said it would benefit wells in several villages which they named, such as Bhain Sagar, Chandarpura, Malpura, which however are not on this nullah at all, nor are their lands in the same catchment, so could not possibly be affected.

There is hardly any culturable land below the site, nor wells on the nullah itself, and the project is therefore not worth further consideration.

Another site to the east of Malpura was also shown me. This is better than the last, as there is more land below, but it is undulating ground and intersected, and the Irrigation Channels would be troublesome to construct, and I do not think the project would pay, or is worth taking up.

Poula Pro-  
ject  
(Site No. 31).

33. Two miles south-west of Harnauda is the village of Poula, and one of the tributaries of the Au river rises in the hills  $2\frac{1}{2}$  miles south-east of this village, and flows past it in a north-west direction.

This was inspected on 14th February, and there is a good site just above the village for constructing a dam, which would be about 900 ft. long, and has a hilly catchment of  $2\frac{1}{2}$  square miles, capable of storing 35 m.c. ft. and irrigating 350 acres.

This was roughly surveyed in 1892-93, but nothing further seems to have been done, and it is not mentioned by Mr. Tickell.

Poula is a khalsa village, with about 12 wells which irrigate 30 bighas; and there is about 60 bighas of good land unirrigated.

Lower down there is the village of Pouli, the lands of which would also be commanded by the tank, so its construction is recommended, and surveys, Plans and Estimate will be prepared.

Lowaria.  
(Site No. 32).

34. Crossing the hills south-east we came to Lowaria, where there is another tributary nullah of the Au.

A tank of this village is suggested by Mr. Tickell, as No. 14 in Appendix E. of his Report.

There is a site above the village where a tank could be constructed, but it is not required, or wished for by the villagers, as it would submerge about 200 bighas of "mal" land, which are cultivated in the Kharif; and below the only land is already irrigated from wells (kutchas) of which there are about 50 in use. Water is about 25 ft. below surface, and the villagers informed me never gave out.

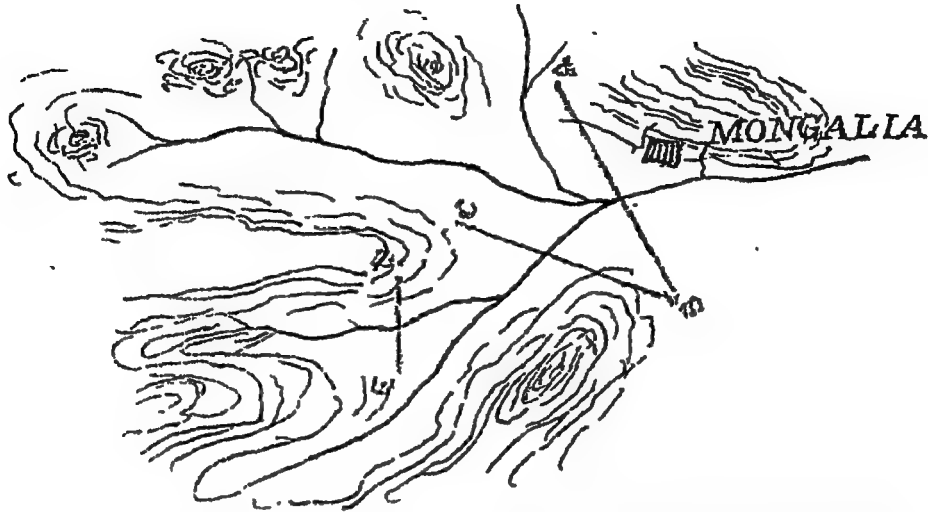
Mangalia  
Project  
(Site No. 33).

35. We then crossed the hills to the south-west to Mangalia, a Khalsa village, on the slope of a high hill, where in old days was a fort.

Three nullahs rise in the hills to the west and south of the village, opposite which they join, and flow onwards in an easterly direction to the Au.

Mangalia possess about 25 wells, irrigating about 80 bighas, and has also about 300 bighas of "mal" land unirrigated. There are small villages lower down the valley, which are Jagir.

Three lines for a dam suggest themselves:—



- (a) "A B" to dam all 3 nullahs, with a hilly catchment of  $2\frac{3}{4}$  square miles, giving  $38\frac{1}{2}$  m.c.ft. of water for storage.

This would submerge 2 wells, one belonging to Gobindpura village, and the other to Mangalia, and 26 bighas of irrigated and about 150 bighas of "mal," cultivated in the Kharif. The land below is not sufficient to compensate for this, so this line may be neglected.

- (b) "C B," which dams two nullahs, with a catchment of  $1\frac{1}{2}$  square miles and possible storage of 21 m.c.ft. This only submerges about 125 bighas of "mal" land, a great portion of which would be cultivated with wheat as the water receded.

- (c) "D E." This only dams one nullah, with a catchment of  $\frac{3}{4}$  square mile, and possible storage of  $10\frac{1}{2}$  m.c.ft.; with this about 50 bighas of "mal" land will only be submerged. This is the site the villagers themselves want, and say is sufficient for their own requirements.

Surveys and Estimates and Plans for both "C B" and "D E" will be prepared, and the Durbar can then decide which should be carried out as most advantageous to the State, irrespective of the requirements of Mangalia village alone.

36. Mr. Tickell (No. 15 of Appendix E) suggests a tank at Dug. The old tank, which is the only one with a catchment approaching 6 square miles, the figure given by Mr. Tickell, breached 100 years ago, and nearly 50 wells, irrigating 300 bighas, have been constructed in the bed, and there are also about 900 bighas of "mal" land cultivated in the rains. Closing the breach would therefore do nothing but harm.

Dug.

There is, however, a site (Site No. 34) where a tank might be constructed at little cost and with great benefit, about a mile to the south of Dug town, across the valley at the head of which is Girdarpura village.

This is all barani land, partly cultivated in the rains, and the water of the nullah in the centre of the valley passes away in the rains and is lost.

An earthen dam is all that is required, starting from the low hill, on the west of the road to Chokri Chota, on the right bank of the nullah, across to the high ground on the left.

There is plenty of good land below, all of which could be irrigated, and the bed of the tank itself would all be cultivated. The catchment area is 1 square mile, but can be increased to  $1\frac{1}{2}$  square miles as the nullah on the north of the site, and south of Dug city, could easily be diverted into the catchment by constructing a short bund, with a cut through the ridge above it.

This is a most promising project and should pay well. If not carried out before it would form an excellent relief work, whenever these should have to be again opened.

Surveys, Plans and Estimate will therefore be prepared.

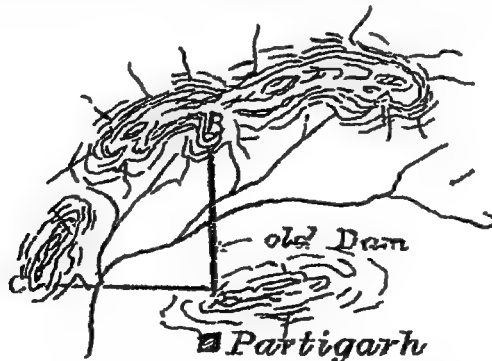
Chota  
Chokri  
(Site No. 35).

37. A tank was suggested here by Mr. Tickell (No. 16 in his Appendix E), and from the topographical Survey Map looked a good site.

It was inspected on 14th February, but is not feasible, as if constructed the tank would submerge all the wells and irrigated land of the village, and leave very little land below, which is at present jungle and uncultivated. There is a fine valley of "mal" land above and east of the village, and this could only be commanded by a tank formed by constructing a dam between the Chokri Bara hill on the left bank and the Jagirpura hill on the right, where a very fine tank could be formed, but these are Jagir villages and the tank would submerge their valuable irrigated land, so is really not to be considered.

Partigarh  
(Site No. 36).

38. The nullahs north-west of Dug were inspected on 15th February. At Partigarh,  $2\frac{1}{2}$  miles north-west of Dug, there are the remains of an old earthen dam, across a nullah issuing from the hills north of the village, which has been lying breached for years. The villagers are very anxious for this dam to be restored, line "A. B."; but it would be better to alter the line to "A. C.," to take in another nullah and enlarge the catchment by  $\frac{1}{2}$  square mile, as the cost of constructing



either will be practically the same. "A. C." will submerge 1 kutchi well and 4 bighas of land irrigated from it, but the extra catchment should bring in an additional  $3\frac{1}{2}$  m.c.ft. of water, sufficient to irrigate 35 acres, so that the advantages outweigh the disadvantages.

Partigarh has 36 wells irrigating 130 bighas, but there are also nearly 400 bighas of "mal" land unirrigated, so the larger the tank the better. Surveys for this will be made and Plans and Estimate prepared.

39. The two main nullahs, of which the Partigarh nullah is one of the many tributaries, unite below Dadalai village, and here a very large tank, with a catchment of        square miles, capable of storing m.c.ft., could be constructed.

Dadalai  
Project  
(Site No. 37).

The project would be an expensive one. The dam would be a mile in length, starting from the hill on the left bank in the south to the small hill by Dadalai village on the right bank, and continued on the other side to the north till high ground and another low hill is reached; and as the nullahs run in deep banks, and the land on either side forming the bed is high, a high dam would be required.

Though there is a large area of "mal" land in the bed, which is at present only cultivated in the Kharif, and which would produce wheat if the tank was constructed, it is doubtful if there is sufficient land below for so large a project, and there are certainly not enough cultivators at present, so that it does not seem worth while making surveys. If, as I was informed, kutchha wells only cost Rs. 25 to construct, and yield a revenue of Rs. 9 per annum (each well can irrigate 3 bighas), it would, it is thought, pay the State well, provided cultivators are available, to construct a large number of wells in this basin.

In the existing wells water appears to be about 30 ft. below the surface, and about 10 ft. deep.

40. Further west, at Jamunia, there is a good site for an earthen dam, about 1 mile long, across the valley and above the village, connecting the hills on either side. Jamunia possesses about 18 wells irrigating about 40 bighas of land; these would be below the dam, and there is a large area of good land also, about 800 bighas, available for irrigation. No good land would be submerged. The catchment area is  $3\frac{1}{2}$  square miles, sufficient to supply  $22\frac{3}{4}$  m.c.ft. of water for storage, at 10 per cent. of rainfall. This should be a paying project, and Surveys, Plans and Estimate will be prepared.

Jamunia  
Project  
(Site No. 38).

Mr. Tickell suggests a tank here, No. 18 of Appendix E.

41. Mr. Tickell suggests a tank at Kuchnia (No. 19 Appendix E), and the nullah which flows past this village was inspected from Nawalkhera downwards.

Kuchnia  
(Site No. 39).

Nothing, however, appears feasible here, nor is a tank required at Kuchnia, as the wells here are good, 5 wells irrigating 60 bighas.

42. At Rojana,  $2\frac{1}{2}$  miles north-west of Kuchnia, the condition of the wells is different, and the water in them has fallen considerably, and out of the 40 wells belonging to the village only 30 are in use and irrigate on an average  $1\frac{1}{2}$  bighas each. The villagers are therefore most anxious for a small tank to be constructed at the head of the nullah above the village as they feel sure this will benefit the wells. The site was shown me, but the catchment is very small, not more than a  $\frac{1}{4}$ -mile. The Assis-

Rojana.  
(Site No. 40).

tant Engineer should make the necessary surveys, and the work might be sanctioned to be carried out by the Tehsil. There is rock in the nullah bed, and the soil on either bank is stoney, so a core-wall will be necessary.

Tanks not  
necessary  
in the  
Gangrar  
Tehsil.

43. The soil in this Tehsil is much more rocky than in the rest of the State, and even where there is "mal" land the greater portion has no depth, the rock being close to the surface; and where this occurs only Jowar can be grown in the rains; the soil is not good enough, I was told, to produce wheat, even if irrigated; so that tanks are of little use, as the irrigable land is small in area.

Where good "mal" land fit for irrigation is found near the villages, opium is the crop the villagers cultivate, and are accustomed to; and this, I am also informed, cannot be irrigated from tanks, as tank water is too cold and the warmer water of wells can alone be used.

Small tanks, such as that asked for at Rojana to benefit the wells, appears to be all that is required in this Tehsil.

Chota Kalisind River.

44. In Appendix E. of his Report (No. 20) Mr. Tickell writes: "The Chota Kalisind river which passes near Gangdhar and has a drainage area of about 900 square miles might be bunded up near Sarwar and the irrigation of nine villages could be effected by two canals, totalling about 20 miles. The Kharif irrigation could be done by the natural flow of the river and the tank reserved for the rabi."

On 17th February I inspected the country on right bank, riding from Gangrar to Sarwar via Sonari, Sekla, and Barlia villages, crossed the river at Sarwar, returning by Sari, Berla and Pipakhera villages on the left bank of the river.

At Sarwar the river is 350 ft. wide, the right bank is 55 ft. high, and the left 35 ft., and throughout its course it runs in deep banks till it widens out above Gangrar, where it is over 700 ft. wide with banks about 18 ft. high. The country that would be irrigated, if a dam was formed as proposed by Mr. Tickell, is therefore very high; it is also broken up by cross drainage, and the good irrigable land is limited in extent, and the larger part of the land commanded is stoney and unprofitable.

There is no site for a dam at or near Sarwar, and any project on so large a river would be very expensive, and a large quantity of the water stored would be in the bed of the river itself and useless for irrigation.

Mr. Tickell's proposal is therefore, in my opinion, not feasible.

Tank on  
Nullah  
between  
Sekla and  
Barlia Vil-  
lages  
(Site No. 41).

45. The only thing to do is to try and make use of the tributary nullahs, and these appeared a good site for a small tank on the nullah which passes between Sekla village on the north and Barlia on the south.

The catchment is  $1\frac{1}{2}$  square miles, rocky, hard soil; so quite 15 per cent. of rainfall would be stored, or 16 m c.ft. The basin is good, and consists of unculturable soil, but just below there is a stretch of barani land, on which Jowar is now grown in the Kharif, belonging to Padmakheri village. This would all be commanded and wheat could be produced. The Assistant Engineer might make further investigations, and if the project is approved by the revenue authorities, have surveys made and prepare necessary Plans and Estimate.



46. At Jaitakheri, a mile north-east of Gangrar, there are two tanks, built many years ago. The larger, "Dilsagar," is half a mile to east of the village, and the small "Nanka" tank at the village itself. Neither has any sluice, and this year the water was being lifted from the "Dilsagar" and carried by a trench across the bund to irrigate a small area below.

Tanks at  
Jaitakheri  
(Site No.42).

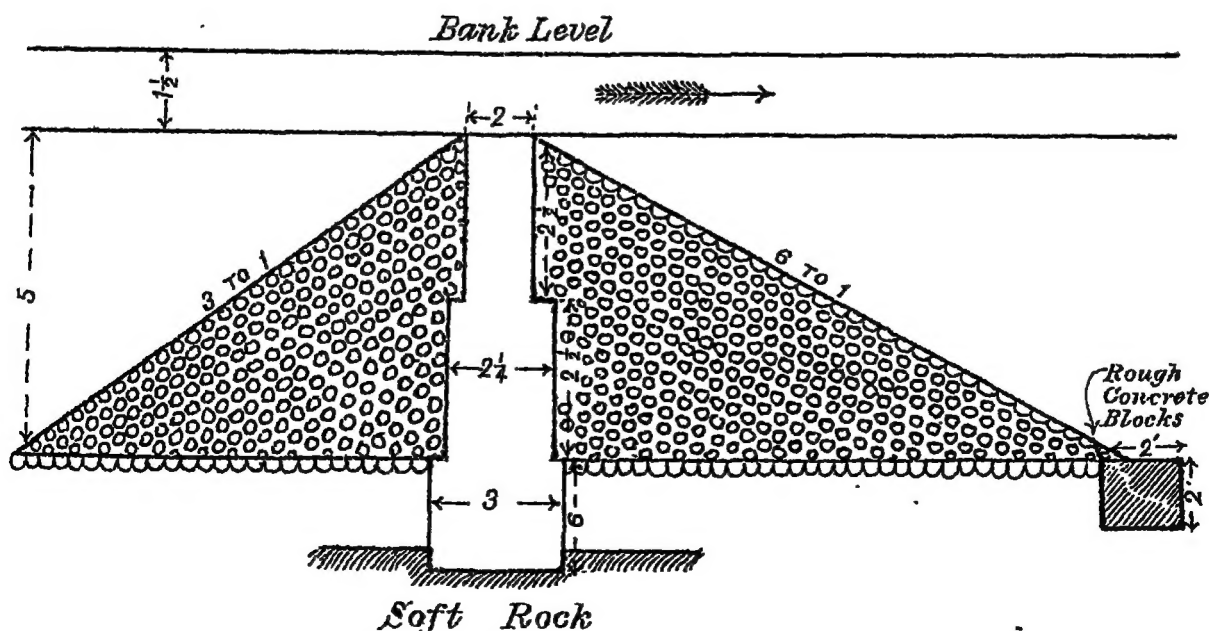
But a sluice and irrigation channels could be constructed at little cost, and as there is land below which could be irrigated and is at present not used, it would, it is thought, be worth while having this done ; and the Assistant Engineer might prepare an estimate for the same.

47. Mr. Tickell proposes a tank at Dokar Kheri (No. 22 Appendix E), a village 6 miles south-west of Gangrar. This was inspected on 18th February. The village is a small one, and possesses 5 wells, and a few "odis" on the edge of the nullah, and 400 bighas of "mal" land, of which 50 can be irrigated if all the wells are in use. This year, owing to scarcity of water, only 3 wells are in use, and 10 bighas of land irrigated. The land on either side the nullah is very stoney, and the 400 bighas noted above are all that is available for irrigation.

Dokar-  
kheri  
(Site No.43).

Though a tank, could be formed above the village, the basin is narrow, and the land rises quickly on either side, so that it would necessitate a comparatively high dam, and would not pay ; but something should be done to help the wells and "odis," and benefit the village, and a weir might be constructed at little cost below the village to hold up the water.

The weir would be about 100 ft. long and 5 ft. high. The sketch shows what is proposed, a wall of stone in line in the centre forming a backbone, founded well into the soft rock, which is found about 5 ft. below the nullah bed, and taken into each bank about 15 ft. to prevent water cutting round, and a front slope of boulders 3 to 1, with rear slope of 6 to 1, consisting of very large stones, with heavy blocks of rough concrete at toe, to prevent rear slope sliding.





If it is found after excavating that the substratum of rock can be depended upon, it might perhaps cost less to make a "pucca" weir at once, the masonry being thicker than the core-wall proposed with a water cushion, the bottom of which would be on the rock below, between the concrete blocks and the weir, the concrete blocks being brought nearer to the weir, say 15 ft. distant only.

The Assistant Engineer might prepare alternative Estimates for these.

Semli  
(Site No. 44)

48. At Semli, a village 8 miles north-west of Gangrar, Mr. Tickell has also a proposal for a tank (No. 21 Appendix E). This was inspected on 18th February. Semli is a very small village of 6 houses, and there are only 3 cultivators in the village. Though there is a good catchment area for a tank, there is practically no land to irrigate, as there is high stoney land on either side, the valley contracting below Semli village, which has only 22 bighas of irrigable land altogether; and Chipria, the village below on the nullah, has only 40 bighas.

But Semli village also wants assistance, as this year only 4 of the 7 wells are in use, and 15 bighas of land irrigated for want of water.

Here also I would suggest that a weir should be built just below the village, at a site pointed out to the Assistant Engineer, to hold up water for the benefit of the wells and which might be also raised by odis. There is rock in the river bed, and the nullah is 100 ft. wide from top of bank to bank. The weir should be similar to that proposed for Dokarkheri, and should not cost more than Rs. 200 to construct.

Summary  
of Investi-  
gation.

49. This completes the Investigation, as nothing more seems possible in this Tehsil, in which though there are plenty of nullahs there seems little means of making use of them, except as suggested by weirs at the villages to assist the wells, as the irrigable land is so limited, and the villages so small and sparsely populated.

The following is therefore the list of projects which are recommended and for which surveys will be made, and Plans and Estimates prepared:—

#### PATAN TEHSIL.

- (1) Shamin.
- (2) Ram Nawas Ghatod.
- (3) Rewa River Project at Khod.

#### PANCHPAHAR TEHSIL.

- (4) Gunjpura.
- (5) Naka Sarna near Guraria

#### AWAR TEHSIL.

- (6) Gugwa.
- (7) Sinhpura.
- (8) Khandar.
- (9) Rajpura.
- (10) Baria (2 Tanks).
- (11) Benaiga (2 Tanks).

## DUG TEHSIL.

- (12) Poula.
- (13) Mangalia (2 sites).
- (14) Dug (1 mile south of town.)
- (15) Partigarh.
- (16) Jamunia.

In addition to these the following have been suggested to the Assistant Engineer who says he can have them worked out locally, and if when they are being prepared I can give any assistance, I shall only be too glad to do so:—

## PATAN TEHSIL.

- (1) Sarangakheri—Revised Project.
- (2) Jarer.
- (3) Motipura—Estimate to be revised.

## PANCHPAHAR TEHSIL.

- (4) Ratanpura.
- (5) Sarod.
- (6) Deori Feeder.
- (7) Estimate for completion of Hatunia Tank.

## GANGRAR TEHSIL.

- (8) Rojana.
- (9) Barlia.
- (10) Weir at Dokarkheri.
- (11) Sluice and Irrigation Channels to Dilsagar at Jaitakheri.
- (12) Weir at Semli (Galot).

When these are worked out, the Durbar will have a large programme available, to be carried out gradually ; and when completed the State should be fairly well protected against Famine.

To make full use of what is proposed, more cultivators are required ; with these obtained the State should derive great financial benefit from the works proposed, in addition to their protective value.

A fixed sum should be set aside for carrying out what is suggested, and any work decided on and sanctioned should be finished right through, including Irrigation Channels, before another is started, so that a return on the expenditure incurred may be derived from each as soon as possible.

It is no use starting a number and leaving them half finished. If a large work is decided on, which will take up the grant for 2 or 3 years, no other new work should be started till that is completed ; but in the present condition of the finances and population it is thought small works should first be carried out, and with the opening of the railway, if land on most lenient terms at first is offered, it is hoped that cultivators from outside will see the natural advantages of the soil and come to settle in the State, and the demand for land and water will necessitate the execution of the larger works proposed.

F. ST.-G. MANNERS SMITH,  
SUPERINTENDING ENGINEER,

AJMER,  
February 1905.

*Protective Irrigation Works, Rajputana.*